Naturally CO2-rich water springs in Belgium evidencing complex subsurface interactions

Presentation · May 2020

DOI: 10.5194/egusphere-egu2020-8011

7 authors, including:

Kris Welkenhuysen
Royal Belgian Institute of Natural Sciences
46 PUBLICATIONS **109** CITATIONS
SEE PROFILE

Agathe Defourny
University of Liège
4 PUBLICATIONS **0** CITATIONS
SEE PROFILE

Alain Dassargues
University of Liège
275 PUBLICATIONS **4,147** CITATIONS
SEE PROFILE

Kris Piessens
Royal Belgian Institute of Natural Sciences
99 PUBLICATIONS **374** CITATIONS
SEE PROFILE

Naturally CO_2-rich groundwater springs in Belgium evidencing complex subsurface interactions

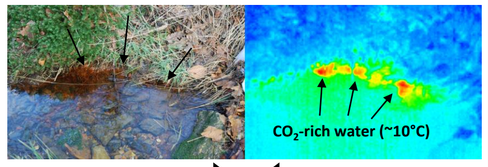
Kris Welkenhuysen[1], Agathe Defourny[2,3], Arnaud Collignon[3], Patrick Jobé[3], Alain Dassargues[2], Kris Piessens[1], Renata Barros[1]

[1] Royal Belgian Institute of Natural Sciences, Geological Survey of Belgium, Jennerstraat 13, 1000 Brussels, Belgium; [2] University of Liège, Hydrogeology, Urban and Environmental Engineering, Quartier Polytech 1, Allée de la Découverte, 9, Bât. B52 - Sart Tilman 4000 Liège, Belgium; [3] Spadel S.A., Water resource department, Rue Auguste Laporte 34, B-4900 Spa, Belgium

A story of water and bubbles

Numerous naturally ferruginous and CO_2-rich (up to 4g/L) springs, locally known as **pouhons**, occur in the Belgian Ardennes

These waters have attracted economic and touristic interest for centuries, being exploited since the 14th century and bottled and exported since the 16th century



Where is the CO_2 coming from?

Two main hypotheses:

a) Generation by dissolution of carbonate rocks and/or carbonate nodules at depth

✓ Crustal (heavy) C isotopic signature in CO_2

✗ Unconfirmed presence of carbonate rocks at depth in the area

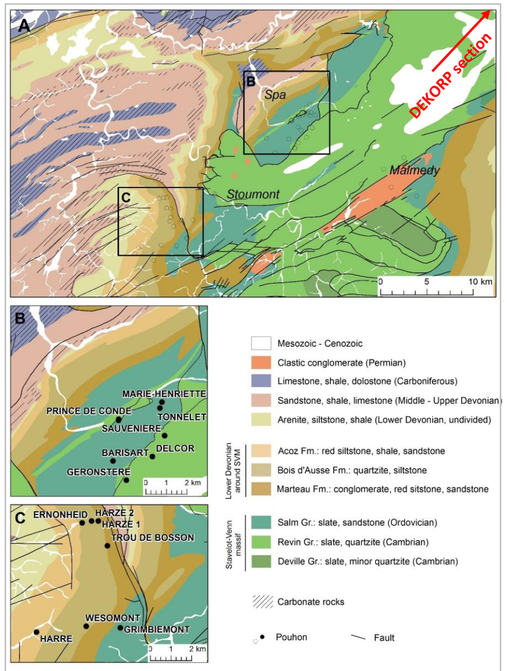
b) Volcanic degassing related to the neighbouring Eifel area in Germany

✓ Mantle He isotopic signature in CO_2

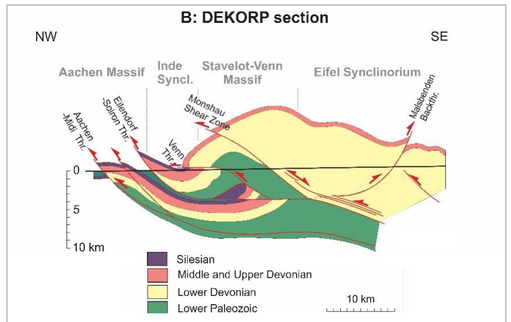
✗ No magmatic reservoir known at depth in the BE side

Physico-chemical characterisation of spring waters and understanding of the geotectonic evolution of the region remain largely unrelated

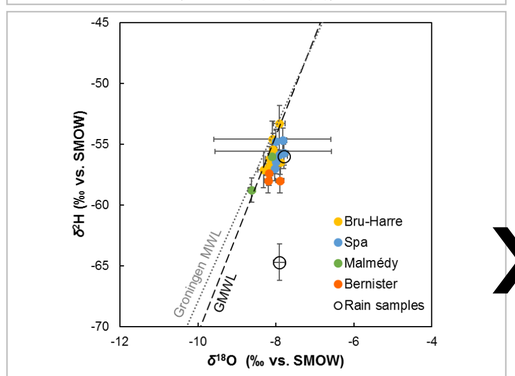
Geological setting & geochemical characterisation



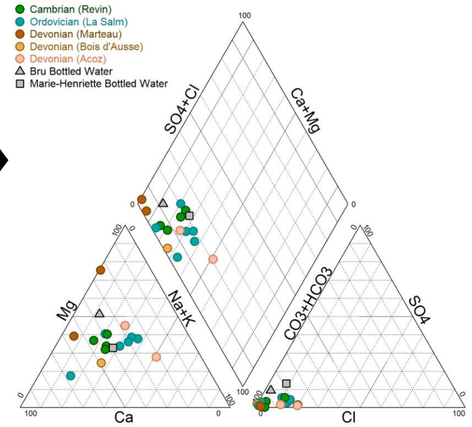
Geology of east Belgium and location of pouhons studied



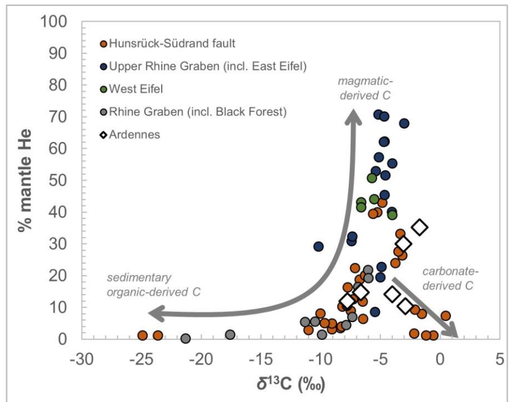
Interpreted location of carbonate rocks (Silesian) at depth (source: [1] and [2])



H-O isotopic signature of pouhon waters within the Global Meteoric Water Line (data from [3])

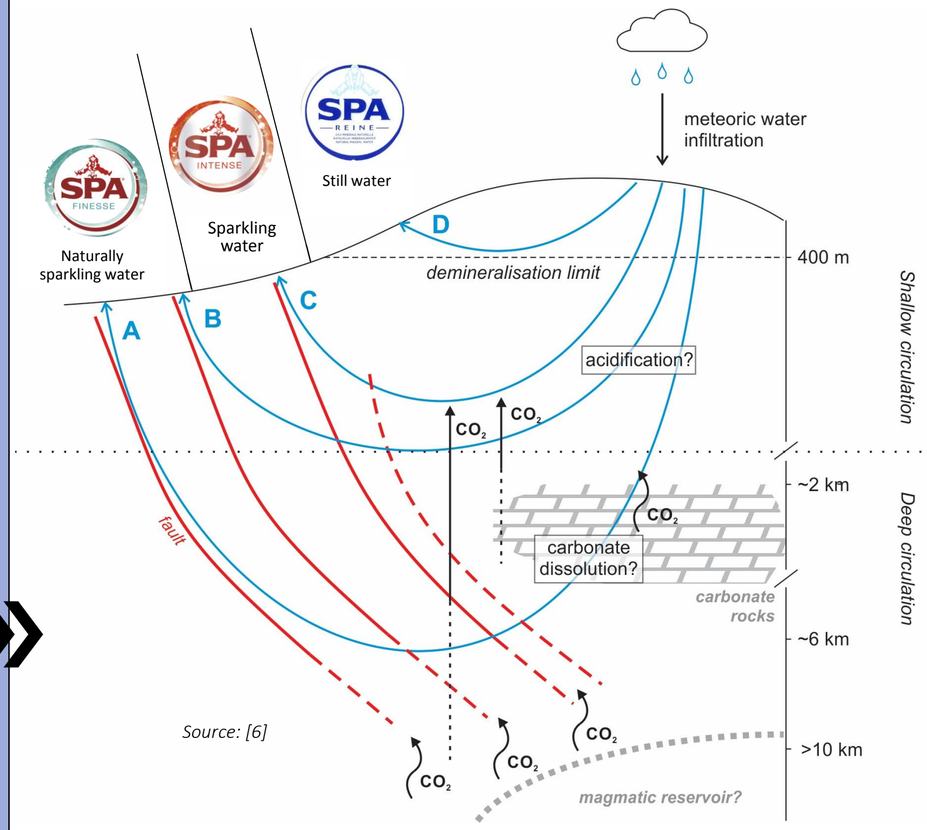


Differences in cation dominance in pouhon waters (data from [4])



C and He isotopes of CO_2 gas phase in pouhons and neighbouring areas (data from [5])

What does it tell us about what happens in the subsurface?



Source: [6]

- H-O isotopic signature shows water is primarily meteoric in origin; He and C isotopes point to a mixed crustal and mantle origin for CO_2
- Previous studies favouring either CO_2 origin from carbonate dissolution or from volcanic degassing inferred deep circulation (>2km) is needed, followed by rapid ascent, which contrasts with low temperatures of springs
- We suggest CO_2 moves upwards to meet shallow aquifers; faults may act as pathways
- The occurrence of mofettes (dry CO_2 sources) in the region could be linked to such transport

Future work aims to provide new results on the isotope geochemistry of pouhon waters to determine the origin of CO_2 with greater detail

Keep posted: https://geoera.eu/blog/category/geo-energy-theme-posts-and-events/geoconnect3d-posts/

References:

[1] Fielitz, W., 1992. Variscan transpressive inversion in the northwestern central Rhenohercynian belt of western Germany. Journal of Structural Geology 14, 547-563.
[2] Vanbrabant, Y, 2001. Evolution géodynamique de la partie orientale de l'allochtone de l'Ardenne. Observations structurales et modélisations numériques. PhD thesis, Université de Liège, Faculté des Sciences, 350 p.
[3] Monjoie, A.,1997. Etude des eaux carbogazeuses du sud-est de la Belgique. Grant Spadel report 971, 51 p.
[4] Spadel internal data.
[5] Griesshaber, E., O'Nions, R.K. & Oxburgh, E.R., 1992. Helium and carbon isotope systematics in crustal fluids from the Eifel, the Rhine Graben and Black Forest, F.R.G. Chemical Geology 99, 213-235.
[6] Barros, R., Defourny, A., et al. (under review) A review of the geology and origin of CO2 in mineral water springs in southeast Belgium. Geologica Belgica.

Acknowledgements:

Funding by the ROSEAU project (Walloon program « Doctorat en Entreprise »), co-funded by the SPW Région Wallonne of Belgium and the company Bru-Chevron S.A. (Spadel group), under grant No 7984

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731166